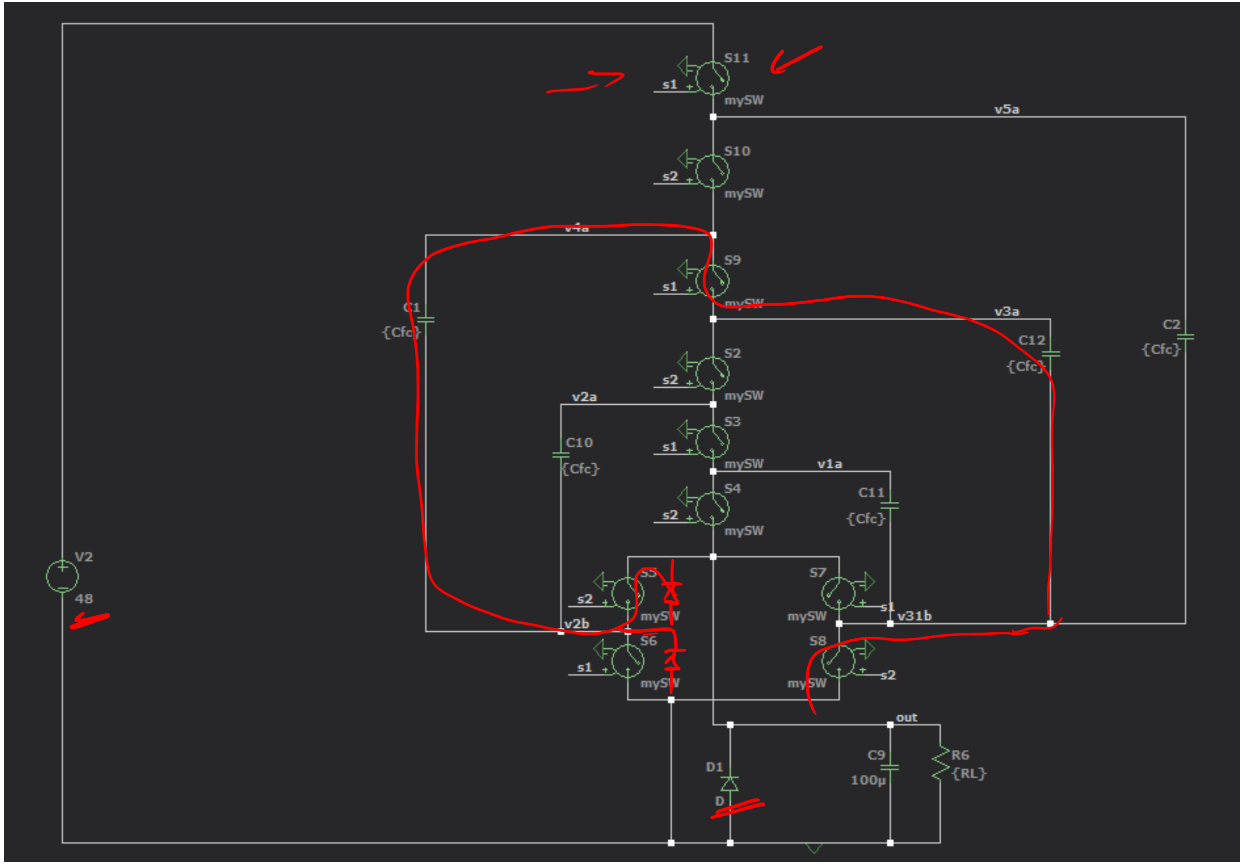
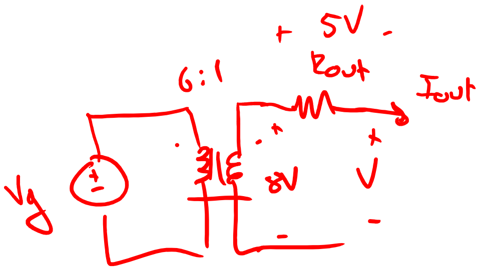
6:1 Dickson Converter Simulation

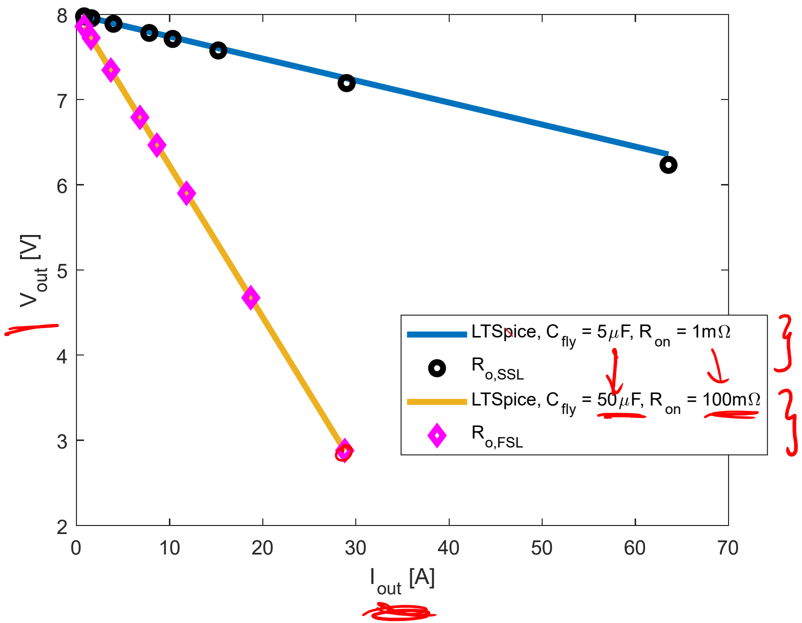


Simulation Comparison to Model

fixed f_s= 1MHZ

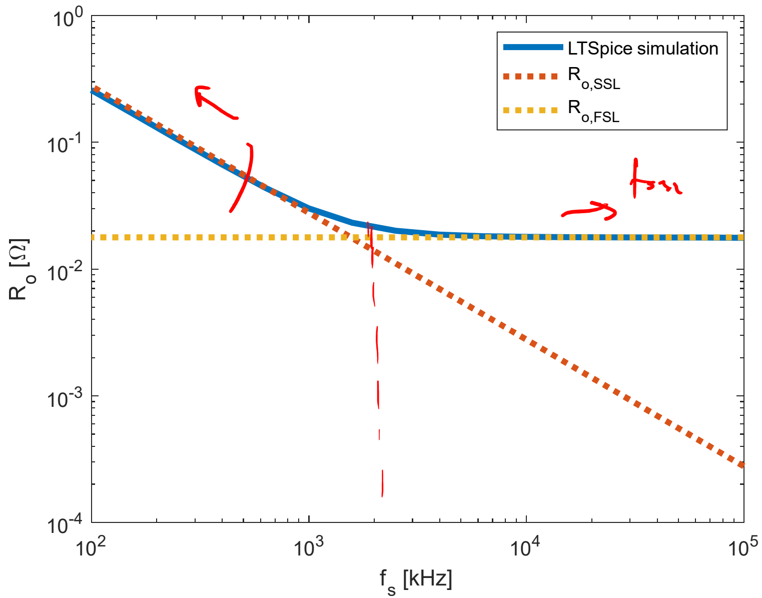
$$f_x = \frac{1}{2\pi R_{on} C_{fly}} = \begin{cases} 300\text{ kHz}, & R_{on} = 100\text{m}\Omega \\ 30\text{ MHz}, & R_{on} = 1\text{m}\Omega \end{cases}$$



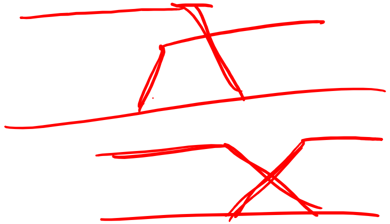


R_o vs Switching Frequency

fixed R_{on}= 10mΩ, C_{fly} = 5µF



Switching Losses in SC Converters



In SSL

- Full C_{oss} loss @ every FET turn-on
- $\approx \emptyset$ turn-off loss
- Minimal ($\approx \emptyset$) P_{ov} loss → some in FSL but much less than in L-loaded HB

  May need to carefully look @ L_{par}

Hybrid | Resonant Implementation

- L_f or L_r added
- May have FETs with both $P_{ov} = \emptyset$ & $P_{ov} = \frac{1}{2} V I_L t_{ov} f_s$

Charge Sharing Loss and Soft Charging

charge sharing:

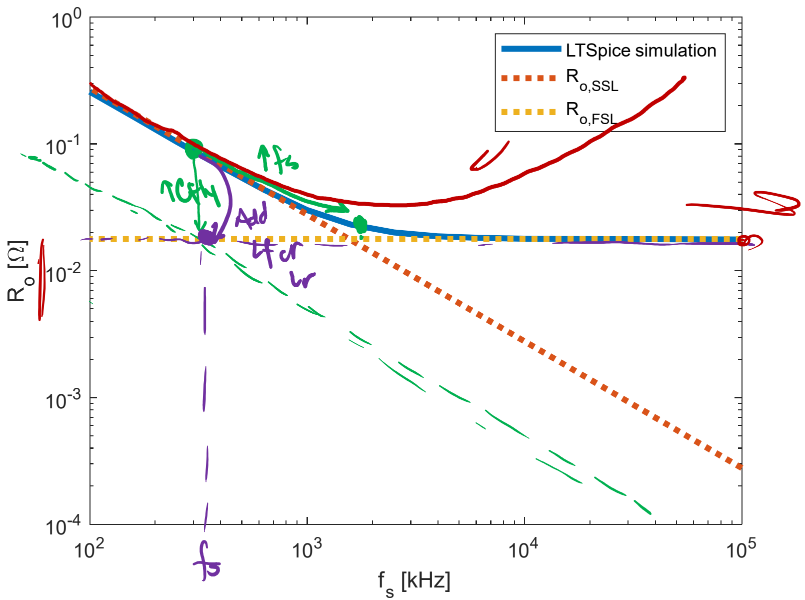
Loss that occurs from C-C or C-V type charging $E = \frac{1}{2}(V_2 - V_1)^2$

Soft Charging:

Remove losses associated with charge sharing beyond base conduction loss

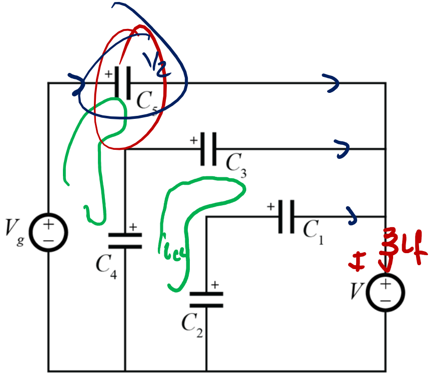
1: Use current source type charging

2: Make sure caps are at same voltage before shorting them.

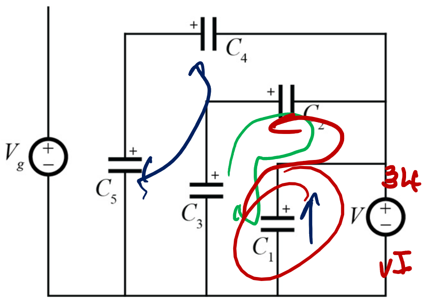


Hybrid Dickson Converter

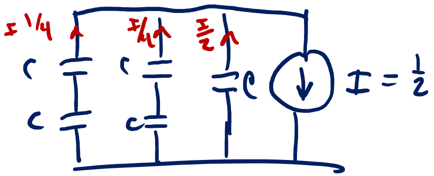
I



II



In either subinterval ac-equiv



Assuming no charge-sharing current

$$\bar{a}^{I} = \left[-\tfrac{1}{4} \quad \tfrac{1}{8} \quad -\tfrac{1}{8} \quad \tfrac{1}{8} \quad -\tfrac{1}{8} \quad \tfrac{1}{4} \quad \tfrac{1}{2} \right]$$

$$\bar{a}^{II} = \left[0 \quad -\tfrac{1}{4} \quad \tfrac{1}{8} \quad -\tfrac{1}{8} \quad \tfrac{1}{8} \quad -\tfrac{1}{8} \quad \tfrac{1}{2} \right]$$

so it can't be true that everything is current source charging